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Gloeckner
CARNATION

MANUAL

PROGRESS IN CARNATION CULTURE

High quality and good production continue to be as important as ever in profitable carnation culture. In addition, the grower in today's economy finds he must time his heavier production to coincide with periods of good demand and at the same time hold his growing costs in line.

The most publicized change in growing methods in recent years, the direct benching of rooted cuttings, keeps these two principles in mind — better control of timing and lower costs of production. As might be expected in such a radical change in procedure, direct benching of cuttings has had its share of successes and failures in its early practice. From these experiences have come modifications and improvements, leading to a sounder use of this new direct method of growing. Many of the lessons thus learned have been incorporated in this year's *Gloeckner Carnation Manual* in the section headed "Direct Benchling."

Gloeckner

Carnation Manual in the section headed "Direct Benchling."

The old adage, "Many a slip twixt the cup and the lip," has often been applicable to carnations from the time they leave the bench until they reach the consumer. During the past year a good deal of progress has been made to correct this through application of new information on cut flower storage. Research on storage is now paying off with the same kind of dividends that growers long have expected of good research on cultural problems. Retail and wholesale growers alike should study these new storage procedures, which make it possible to deliver a better carnation to the consumer, keeping always in mind that satisfied customers are repeat customers.



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At Madison Square

CONTENTS OF CARNATION MANUAL

| | | | |
|--------------------------------|-------|----------------------------------|------------|
| Carnation Culture | 4-14 | Insecticides | 25 |
| Direct Benching | 1-3 | New Introductions | 21, 22, 24 |
| Diseases & Their Control | 14-20 | Price List | 21-24 |
| Faster Production | 1-3 | Yoder Bros. Varieties 1953 | 21 |
| Insects & Their Control | 20 | Yoder Bros. Varieties 1952 | 22 |

TERMS OF SALE

One hundred cuttings of each variety is the minimum that can be supplied, except on those varieties where a 50-rate price is quoted. More than 100 of a variety must be in multiples of 50.

Any changes or cancellations of carnation orders must be received at least six weeks before shipping date.

Fred C. Gloeckner & Co., Inc., gives no warranty, express or implied, as to the productiveness of any seeds, bulbs or plants it sells and will not be in any way responsible for the crop. Our liability, in all instances, is limited to the purchase price.

DIRECT BENCHING

THE DIRECT ROUTE TO GOOD CARNATIONS

A method of producing carnations in a shorter time and with less labor and lower costs should interest every carnation grower. This has been done with amazing success recently by direct benching of rooted cuttings. This method does away with either one or two transplanting processes, depending upon the present method used. Several months of preliminary growing are eliminated through properly timed propagation. Furthermore, better timing to hit the best sales periods appears to be more nearly attainable with this method of faster growing. The key to the success story of direct benching of rooted cuttings is that plants grown this way are never retarded in growth, have less chance of disease infection and break more freely and grow faster.

PROPAGATION CHANGES

Instead of the usual procedure of midwinter propagation, heavy cuttings are rooted as needed, timed so that they are ready to plant direct in the bench as soon as it is cleared of a previous crop and the soil readied for planting. The cuttings must be **vigorous, plump and free from disease** — the kind that can best be secured from strong, healthy mother block stock plants. For direct benching, strong top cuttings are superior to heel cuttings.

PLANTING TIME

Direct benching of rooted cuttings may prove to be a round-the-clock operation, with various propagations and plantings aimed at specific cropping dates. However, the experience thus far shows direct benching to be particularly useful for planting from March through early July. Never plant the cutting any deeper than it was in the propagating media.

SPACING

Avoid the temptation to double up or plant close. Use standard spacing. The rapid heavy growth and heavy bottom breaking fill up the bench much faster than might be expected.

PINCHING

Pinch once and only once, one month after benching the rooted cuttings. By that time the breaks or shoots will be well started along the stem of the young plant or cutting. Having four to eight breaks, measuring one-half inch to two inches in length is not uncommon by the time the direct-benched cutting has been in the bench for one month and is ready for the first and only pinch. After the top of the cutting is pinched out, these side shoots or breaks develop and elongate at a fast pace. This single pinch **must be made high** to assure enough breaks — merely remove the tip of the young plant.

To avoid heavy cropping at one time some growers pinch part of the shoots that develop after the first pinch. This second pinch should be delayed until after the shoots are 8 or 9 inches long.

FERTILIZING

Excellent results have been obtained by giving a light liquid feeding ten days to two weeks after benching. Subsequent feeding and watering should be adequate to maintain active, vegetative growth constantly.

NO PINCH METHOD

Some growers who have practiced direct benching favor no pinch method. The plant is allowed to grow and produce a bloom before the plant is stopped. When cuttings are planted during winter and early spring the first bloom is of very high quality. The breaks appear before the bloom is cut and very little difference can be detected from the usual pinched plant.

CROPPING TIME

Information on cropping time is by no means complete, but it is apparent that with experience timing will be more accurate than with other methods of growing. One reason is that the first crop of flowers from a single pinch tends to be grouped more closely than when plants have been pinched several times. The subsequent crops are more scattered.

(Continued)

Gloeckner CARNATION MANUAL

CROPPING TIME—Cont.

The comeback with this method of growing has been more rapid than with other methods. On a number of varieties, the second-crop shoots have attained considerable length before the first crop is cut. This comeback rate is significant in achieving a good total production yield. One of the country's outstanding carnation research men has this to say about production with the direct-benching single-pinch method: "We do not think we are sacrificing production and are certain that the production obtained can be timed for best market periods more accurately."

The tables on page 3 show the production and timing of crops with direct benching, single pinch.

ADAPTING THE METHOD

Several possibilities for adapting the method to commercial production already are apparent. In those ranges where culture is always under glass, no adaptation problem exists. The rooted cuttings can be benched as late or later than young plants that have been propagated much earlier and held in pots, bands, flats or transplanting bench. Experience has shown that the rooted cuttings, unchecked by extra transplanting, hardening, crowding, etc., move off faster and catch up with plants propagated as much as three months earlier. A major advantage enjoyed by the direct-benched cuttings is that they break much more freely from a single pinch.

In those ranges where outdoor culture is practiced, adoption of the new method means throwing out the old crop from some benches after Mother's Day, Memorial Day, etc. Since the demand for some colors (red notably) decreases sharply in warm weather, and also since some good winter flowering varieties have decidedly inferior flowers during hot weather anyway, it should not be a handicap to throw out some benches and replant with rooted cuttings in May and June. Advantages gained would include among other things reducing the amount of field planting, cultivating, lifting and benching of heavy field plants, all of which are laborious and costly procedures.

The method is likely to fit into two-year culture, with the possibility of replanting half the carnation space each year with rooted cuttings, and continuing the other half in late spring and summer production. Since absolute disease control is an essential of two-year culture, the method is particularly well suited, since there is less likelihood of contamination when benching cuttings direct.

The grower of miscellaneous crops, wholesale and retail, usually can rotate carnations with other crops and thus have benches free by mid-May or early June where carnation cuttings could be benched direct and still be able to cut carnations from the old crop in other benches. If carnations are a minor crop, it undoubtedly would be advantageous to eliminate all the chores and worries of propagation and care of young plants and procure strong, clean rooted cuttings from a propagation specialist on a specified planting date. The time and space required for home propagation and growing on can be put to use profitably on other crops, thus offsetting the costs of procuring cuttings.

Heavy January production on the variety, Aurora, in Clem Manke Greenhouses, Milwaukee, Wis.
Cuttings benched in Mid-June, pinched once in Mid-July.



Gloeckner CARNATION MANUAL

OBTAINING LATE CUTTINGS

The advent of direct benching of rooted cuttings necessitates some obvious changes in propagation schedules, with a need for cuttings in late spring in addition to the customary midwinter supply. To assure availability, growers should make arrangements as far in advance as possible to procure cuttings. Some propagation specialists are preparing for this demand, and our representatives are informed as to the varietal availability through the late spring months.

PRODUCTION IN AN ILLINOIS RANGE, 1951-52.

CUTTINGS BENCHED DIRECT, PINCHED ONCE.*

| Variety | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June 1-15 | Total | Ave. per plant | Ave. sq. ft. |
|-----------------|------|------|------|------|------|------|------|-----|--------------|-------|----------------------|--------------------|
| Adonis | 15 | 252 | 369 | 223 | 105 | 60 | 87 | 295 | 267 | 1673 | 7.0 | 21.0 |
| Aphrodite | 163 | 491 | 258 | 90 | 31 | 12 | 17 | 66 | 82 | 1210 | 5.3 | 15.9 |
| Apollo | 166 | 333 | 243 | 146 | 33 | 30 | 94 | 326 | 259 | 1630 | 6.5 | 19.5 |
| Aurora | — | 9 | 202 | 410 | 245 | 67 | 58 | 36 | 47 | 1074 | 4.3 | 12.9 |
| Ceres | 151 | 450 | 249 | 146 | 33 | 30 | 94 | 328 | 259 | 1740 | 7.0 | 21.0 |
| Orion | 3 | 158 | 537 | 345 | 127 | 49 | 41 | 51 | 127 | 1438 | 5.8 | 17.4 |
| Saturn | — | 42 | 244 | 337 | 232 | 93 | 103 | 95 | 179 | 1325 | 5.3 | 15.9 |
| Vulcan | 2 | 26 | 143 | 246 | 359 | 127 | 168 | 96 | 414 | 1581 | 6.3 | 18.9 |

*Cuttings benched direct June 14, 1951.

- Pinched only once, July 14, 1951.
- Trials consisted of 250 plants of each variety.
- Cut record shown through June 15, or one calendar year in the bench.
- These trials were on V-bottom ground beds.

PRODUCTION IN A WISCONSIN RANGE, 1951-52.

CUTTINGS BENCHED DIRECT, PINCHED ONCE.*

| Variety | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June 1-15 | Total | Ave. per plant | Ave. sq. ft. |
|-----------------|------|------|------|------|------|------|------|-----|--------------|-------|----------------------|--------------------|
| Adonis | 42 | 383 | 483 | 269 | 147 | 179 | 155 | 238 | 293 | 2189 | 8.7 | 26.1 |
| Aphrodite | 269 | 532 | 238 | 223 | 171 | 103 | 56 | 54 | 162 | 1808 | 7.2 | 21.6 |
| Apollo | 318 | 452 | 382 | 236 | 213 | 256 | 224 | 289 | 622 | 2992 | 12.0 | 36.0 |
| Aurora | 2 | 176 | 625 | 645 | 318 | 235 | 112 | 105 | 158 | 2376 | 9.5 | 28.5 |
| Diana | 15 | 233 | 505 | 279 | 254 | 174 | 133 | 202 | 230 | 2025 | 8.1 | 24.3 |
| Jupiter | 9 | 52 | 269 | 399 | 260 | 344 | 235 | 125 | 82 | 1775 | 7.1 | 21.3 |
| Neptune | — | 26 | 180 | 256 | 342 | 410 | 168 | 160 | 238 | 1780 | 7.1 | 21.3 |
| Saturn | — | 38 | 100 | 250 | 493 | 333 | 148 | 148 | 25 | 1535 | 6.2 | 18.6 |
| Vulcan | 2 | 34 | 71 | 121 | 300 | 181 | 175 | 430 | 115 | 1429 | 5.7 | 17.1 |

*Cuttings benched direct June 15, 1951.

- Pinched only once, July 15, 1951.
- Trials consisted of 250 plants of each variety.
- Cut record shown through June 15, or one calendar year in the bench.
- These trials on raised benches, except for the varieties, Neptune, Saturn and Vulcan.

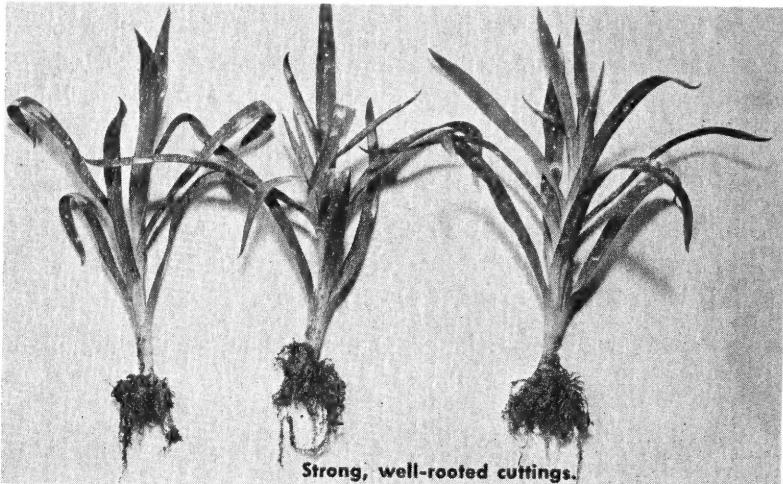
BETTER CARNATIONS CUTTINGS

It takes good carnation cuttings to make good carnation plants. Freedom from disease, plump vigorous growth and trueness to type are three absolute essentials of a good cutting.

FROM FLOWERING PLANTS

The most common procedure is to take cuttings from flowering plants. Where extreme care is exercised in selecting cuttings, varieties can be maintained reasonably free from disease and up to the original standards of the variety. More often, though, selection is not practiced to the required degree, and varieties deteriorate and sooner or later need to be replaced. Selection, when taking cuttings from flowering stock, is laborious because of the large number of plants that need to be examined to obtain sufficient good cuttings.

In selecting: (1) avoid grassy growth; (2) choose vigorous, plump shoots; (3) avoid diseased plants; (4) take cuttings from plants bearing flowers of good color, form and fullness.



Strong, well-rooted cuttings.

MOTHER BLOCKS

Mother blocks are a more satisfactory source of good cuttings than are flowering plants. Consistent users of the mother block system feel that the advantages outweigh disadvantages. The method is used extensively by the better propagation specialists. Mother blocks are grown for the sole purpose of producing cuttings. Potential flowering shoots are pinched back to force more shoots for cuttings, although one shoot per plant may be allowed to flower early in the season to verify the plant for flower type and color. Since each plant in the mother block will produce numerous future cuttings, extra care is taken to select and maintain clean, vigorous and true-to-type stock in the mother block. Plants going into the mother blocks are kept under glass at all times, never going to the field.

The apparent disadvantage of the mother block system is that the bench space occupied does not produce flowers for cutting. However, over a period of time this is more than offset by the production from the flowering plants that are propagated from the vigorous healthy cuttings taken from the mother block plants.

CULTURED CUTTINGS

Laboratory methods are used in some instances to produce "cultured cuttings." The results have been good in controlling two major diseases, fusarium wilt and bacterial wilt. Culturing is a job for a specialist, and not for every grower. In the procedure usually followed, culturing is used to procure clean mother stock or foundation stock, rather than laboratory culturing of all cuttings that will be benched. Additional laboratory methods are in development stages for similarly procuring virus-free foundation stock. Cultured stock, free of certain diseases, can be recontaminated or reinfected. Culturing does not develop resistance.

DISEASE FREE CUTTINGS

A recent and promising development in assuring clean stock to start with is the program to grow propagating stock, never contaminated, under isolated conditions. An example of this is the Yoder Bros. collection of new varieties. From the start young seedlings of potential new varieties are grown entirely apart from carnation contaminating sources. Since the carnation diseases, including viruses, are not transmitted by seed, it is possible thus to start with a clean slate. Maintaining clean stock from that point on is dependent on complete isolation and rigid sanitary and preventive controls. Disease free cuttings obtained thus are not necessarily disease resistant, hence the individual grower receiving these will wisely institute the best control methods available to him in order to keep such stock as clean as possible for as long as possible. With the development of assured sources of disease-free cuttings, individual growers will probably turn more and more to the specialists for annual renewal of their stock.

PROPAGATION PRACTICES

Carnation cuttings root readily enough with average care, but the grower who does not utilize every known precaution of sanitation and give expert attention to his propagation is jeopardizing and taking chances with his entire next year's production of carnations.

TIME OF PROPAGATION

The propagating season normally extends from November to March, with most cuttings made during December and January. The recent trend is to propagate later, or at least to cut down the time between rooting and benching the plants in their ultimate location. The advantages of early propagation in "building a bushy plant" are more than offset by the checking of growth, hardening, crowding and the attendant disease problems when plants are held too long before final benching or going to the field as the case may be. As reported on the forward pages of this Manual, rooted cuttings benched direct make prodigious growth and overtake older plants from winter propagations.

CUTTING TECHNIQUES

To obtain the best carnation plants, two specific goals should be kept in mind in propagating carnations: (1) Root the cuttings quickly and get them out of the sand and into the soil as soon as possible to avoid hardening or checking of growth; (2) Observe every precaution to prevent disease contamination or spread. To accomplish these objectives the following procedures are suggested:

1. Use large, vigorous and disease-free cuttings.
2. Break, do not cut, cuttings from the plants.
3. Do not cut the bottoms or trim the tops of the cuttings with a knife. (High humidity must be maintained and cuttings may require a little more space in the sand if they are untrimmed. However, they will root more quickly and are less likely to become infected with disease.)
4. Dip the lower end of cuttings in **Fermate**. Do not throw them into a **Fermate** solution as this provides an excellent opportunity for the spread of bacterial wilt. Another recommendation which may be even better is to blow the dust onto the cuttings with a puff duster.
5. Use sterilized sand in a sterilized propagating bench.
6. Maintain 60 to 65 degrees F. for rooting.
7. As soon as the roots are $\frac{1}{4}$ -inch long, remove cuttings from the sand and plant in soil. Do not let cuttings stay in the sand to develop a massive root system.

CARE OF YOUNG PLANTS

The myth that young carnation plants need to be hardened has been exploded. All the evidence is in favor of maintaining active growth, root and top. If this means later propagation or greater spacing of your plants, or both, the ends justify the means. Checked plants are a long time recovering, and never completely outgrow damages suffered in the early stages.

As soon as the cuttings are rooted they should be planted in soil — in bands, pots, benches or flats. Advocates can be found for each of these methods, and subsequent handling frequently determines which method is used. Because of the restriction to root action which results in hardening the plants, potting in $2\frac{1}{4}$'s is losing favor. Bands have a greater soil capacity than pots, and while they also restrict root action some, they have the advantage of less disturbance to the roots in later transplanting than is the case when young plants are planted in flats or benches. Spacings of 3 x 4 or 4 x 4 in benches or flats is preferable to closer spacing, since the plants do not ordinarily require additional spacing before the final benching indoors or going to the field. (For direct benching of rooted cuttings see the special text starting on page 1.)

Use a good potting soil or bench soil mixture for the young plants, containing about one-fourth peat or well rotted manure. Sterilizing the soil, as well as pots, flats or benches is advisable, and it is best that the soil be sterilized two or three weeks in advance of planting.

After the young plants are established, frequent light feeding with a liquid fertilizer is an aid in keeping the growth active, particularly where the plants are confined in pots or bands.

Insect and disease prevention are vital at this stage. Remember the crowded conditions under which young stock too frequently is grown makes the spread and increase of pests easy.

In planting or transplanting cuttings or young plants always plant shallow, or, never deeper than they had previously been set in sand or soil.

SOILS AND FERTILIZERS

Carnations grow well in a variety of soils, but fibrous loam soils which remain reasonably porous and permit free drainage of surplus water throughout the growing season are easiest to manage. Blue grass sod, to which rotted manure has been added plus an application of superphosphate, gives uniformly good results. Since the average carnation crop will be in the bench about a year, attention and time put on good soil preparation are both necessary and justifiable.

STEAM STERILIZATION

Carnations can be grown year after year in the same soil, if it is thoroughly steam sterilized annually and the organic matter replenished. Steaming is a dependable method of eliminating soil-borne carnation diseases, both from the soil and the bench boards. Some growers even sterilize new soils, calculating that the disease-control insurance and the killing of weed seed justify the additional cost.

Results on steam sterilized soil are comparable to those on good new soil, if all of the rules are followed. To avoid some possible pitfalls, the following practices are suggested:

1. Reduce nutrient levels and soluble salt content of the soil prior to sterilization by keeping to a minimum the late feedings on the previous bench crop. Also the last one or two waterings of the preceding crop can be much heavier than usual to accomplish leaching prior to sterilization.
2. Add organic matter to the soil liberally before sterilizing — about one-fourth by volume of rotted manure, chopped legume hay or peatmoss.
3. Steam sterilize the soil so that a minimum of 180° F. is reached and held for thirty minutes in every part of the bench soil.
4. If time permits, leach heavily with water after sterilizing and let the bench stand for a week to ten days before planting.
5. If time does not permit for the procedures outlined in Point No. 4, plant after the soil is cool and accomplish some leaching by going over the bench a half-dozen times with moderate waterings, immediately after benching.
6. Apply 5 pounds of gypsum (calcium sulfate) and 5 pounds of superphosphate per 100 square feet of bench space, and mix into the soil well before planting.
7. Do not use a complete fertilizer at benching time, but wait until after the plants are established and growing.
8. After the original watering-in of newly benched plants, do not let the soil become hard and dry before giving the second and subsequent thorough waterings.

OTHER STERILIZATION

Chemical sterilization of carnation soils is receiving a good deal of attention, and some soil fumigants and chemicals are useful in the control of specific disease, insect and weed pests. For all-round effectiveness, steam sterilization still holds the No. 1 position.

Hot water sterilization is used by growers to some extent, and in some areas is preferred to steaming, probably because the extremely large volume of hot water used to achieve sterilizing temperatures accomplishes something in leaching not ordinarily achieved with the steam method. For thorough sterilization with hot water, the minimum temperature of 180° F., held for thirty minutes, must be satisfied.

NEW SOIL

When sterilizing is not practiced, new soil should be brought in for each successive crop of carnations. Avoid reusing soil that has grown carnations during the previous five years. A good sod soil is superior to field soils that have been in cultivation. Mix about one-fourth by volume of manure, peat or chopped legume hay with the soil. Also incorporate 5 pounds of superphosphate per 100 square feet before planting. Complete fertilizers are better withheld at that time and applied after the plants are established, unless soil tests show decided deficiencies in nitrogen or potassium. The young plants generally start off more rapidly in a lean soil, and are then soon ready for feeding.

Gloeckner CARNATION MANUAL

MAINTAINING FERTILITY

Plant growth and appearance are good guides to fertilizer requirements. Monthly soil testing likewise is a valuable aid. A combination of the two is the best thing available in controlling the fertilizing program.

Soil tests (Spurway) should show about 15 to 25 p.p.m. nitrate nitrogen; 5 to 10 p.p.m. phosphorus; 20 to 40 p.p.m. potassium, and around 200 p.p.m. calcium. To increase the nitrate level, fertilize with sulfate of ammonia at the rate of 1 pound per 100 square feet. Frequently the original incorporation of superphosphate in the soil before benching is adequate to maintain phosphorus levels for the season. If not, superphosphate can be applied in a supplementary way at the rate of 3 to 5 pounds per 100 square feet. To raise the potassium level, muriate of potash can be applied at the rate of 1 pound per 100 square feet. To raise the calcium level, gypsum (calcium sulfate) can be applied at the rate of 2 to 3 pounds per 100 square feet.

As a practical expedient growers may find it desirable to use complete fertilizers instead of the single-element fertilizers mentioned in the foregoing. These can be obtained in different combinations and applied dry or as liquid feedings. Liquid feeding is increasing in use because of the laborsaving in application, plus more even distribution.

Frequent light feedings are safer and preferable to heavier feedings spaced farther apart. Remember also that plant requirements are less during the slow-growing dark winter months than during the periods of rapid growth in spring and fall. In the summer months growth may be rapid, but the high soil temperatures cause speedy breakdown of organic matter in the soil, releasing considerable amounts of nitrogen in this process. Thus excess fertility, particularly nitrogen, can occur at that season. However, recent experiences have indicated that a program of liberal feeding, accompanied by liberal watering during the summer months is advisable from the standpoint of maintaining active growth and keeping the plants vegetative. In timing fertilizer applications, allow for two or three week's lag between application and the beginning of response in the plants.

It has been reported that Patrician carnations had less splits when nitrates were 100 to 140 p.p.m. This reduction of splits by high nitrates is interpreted as being due to a more uniform nitrate level, rather than high level itself.

Excess fertility is not uncommon. When plants stand still, show no new root action and appear yellowish and stunted, excess soil fertility is a likely cause. Leaching is the corrective measure. We recommend (1) a normal watering so that water just drips through the bottom of the bench, followed three or four hours later by two or three extremely heavy waterings that bring the water streaming through the bench bottoms.

SOLUBLE SALTS

Soluble salts are chemical compounds consisting of an acid part or ion and a basic part or ion. For example, common table salt, sodium chloride, consists of one ion of chloride and one of sodium. Chloride is an acid forming ion and sodium a basic or alkali forming ion. The two combine in chemically equivalent quantities to form a neutral salt. Other common acidic ions are sulfate, nitrate, bicarbonate, and phosphate. Other common basic ions are calcium, magnesium, potassium and ammonium. Any basic ion may combine with any acidic ion giving rise to a great variety of salts.

All plant nutrients which are absorbed by plants from the soil or from culture solutions are absorbed in the form of salts or their constituent ions. All organic materials become "Mineralized" through decay processes and the nutrients in them are converted into salts before being absorbed by plants. Some salts contain plant nutrients and are beneficial in the small quantities required for plant growth. Others contain no nutrients. All salts are harmful beyond the small quantity required for plant growth. A little is bad, more is worse, up to the point where plants will be killed. Salts are found in most water and are applied as fertilizer. Improper watering may permit a concentration into the harmful range.

Instruments called Wheatstone's bridges are available which measure total soluble salts in terms of electrical conductivity or conductance. Many laboratories of the Agricultural Extension Service are equipped with Solubridge instruments for use in assisting with soluble salt problems.

It has been found that when planting rooted cuttings, the Solubridge readings should not be higher than 40 while established plants do not withstand readings of 100 without showing some harmful effects. To remedy excess soluble salts apply two to three gallons of water per square foot and leach out this high salt content.

Gloeckner CARNATION MANUAL

ACIDITY

Soils testing near neutral in reaction (pH 6.5 to pH 7.0) are considered desirable for carnations. However, good carnations are to be found growing in a range of from pH 6.0 (acid) to pH 7.5 (alkaline). Hydrated lime and ground limestone are used at rates of 2 to 5 pounds per 100 square feet when soils are too acid, and sulfur is used at 1 to 2 pounds per 100 square feet when soils are too alkaline. Since the reaction is slow in both cases, it is desirable to incorporate these materials, thoroughly, into the soil in advance of planting, if tests show they are needed as corrective measures.

MULCHES

Light mulches of rotted manure, corncobs, spent-hops, buckwheat hulls, peat, etc., are sometimes used during late spring and summer. The value of these for carnations is questionable. Where the mulch is confined to a strip eight or ten inches wide along the south side of a bench, it may reduce the need for touch-up watering in that exposed area during hot weather.

CULTIVATION

Carnation plants have numerous feeder roots near the surface of the soil. If cultivation is used at all, it should be very shallow and chiefly to scrape off weeds that come up in benches of unsterilized soil. It is much better to depend on good advance preparation of soils to keep them open than to cultivate later to loosen them.

OUTDOOR vs. INDOOR CULTURE

Outdoor or field culture during the spring and summer months still is practiced extensively. The trend, though, is toward indoor culture, or keeping the plants continuously under glass or indoors. Planting outdoors enables a grower to keep benches of the previous year's crop in production during late spring and on until midsummer. With indoor planting the benches must be emptied in the spring so that the new crop of carnation plants can be benched. That is about the only advantage or justification of outdoor culture.

The labor involved in outdoor culture is much greater than benching indoors. Disease and insect control is more difficult and complicated and less effective outdoors. When properly handled, indoor culture gives production comparable to outdoor culture, despite the bushy heavy growth that plants make during the outdoor growing period. Apparently the damaging effect of lifting and benching heavy field plants during midsummer provides a check that offsets the heavier growth they make in the field. In any event the shoot count on field plants usually is far in excess of the cut record from the same plants.

Benching in indoor culture is done from April 1 to June 1, with a large proportion of this planting done during the month of May. Field planting is done outdoors as early in the spring as the ground can be properly worked, and after danger of severe freezing weather is past. The plants grow outdoors into July, and are benched before August 1.

OUTDOOR PRACTICES

In field culture, the plants are either set 6 or 7 inches apart in the row, with rows 18 to 24 inches apart for row culture; or, they are planted check-row 6 to 8 inches apart in beds 3 to 4 feet wide. In the bed plantings hand cultivation is used, usually with less damage to the plants than when mechanical cultivation is used in row culture. Some growers using bed culture steam-sterilize the semi-raised outdoor beds, thereby keeping weeding costs down and controlling soil-borne diseases. When sterilization is not used, carnations should not go back on the same field soil in less than five years.

If the young plants are grown in bands indoors, the bands can be left on when planting in the field. Although this practice may restrict root growth some, there is much less transplanting shock later when the plants are lifted and brought indoors.

In field culture, spraying, as discussed in the section on Insects and Diseases, is essential for keeping the plants clean and healthy. Irrigation is not always a necessity, but is particularly valuable at planting time and for use just in advance of lifting the plants from the field.

Benching of field plants indoors should be completed not later than August 1. Careless handling in that operation, resulting in bruising and breaking of tops and roots, will affect production adversely throughout the subsequent flowering season.

Gloeckner CARNATION MANUAL

INDOOR CULTURE

Growers of miscellaneous crops, who can rotate carnations with other crops, find it easier to set up an indoor culture program than those who grow carnations exclusively. Even so, to use bench space effectively and efficiently, planned rotations are necessary. The following rotations are possibilities where houses or benches can be alternated between carnations and other crops every other year:

1. Late mums, followed by single-stem Easter snapdragons, then carnations.
2. Mums followed by lighted asters, then carnations.
3. Mums followed by lighted mums, then carnations.
4. Mums followed by stocks, then carnations.
5. Early winter snapdragons followed by second crop of snapdragons, then carnations.

Early benching of young carnation plants is an important factor in developing well branched plants in indoor culture. Plants benched after June 1 seldom fill the bench well until the following spring. (Note: Rooted cuttings benched direct after June 1 actually break more freely and provide heavier fall and winter production than do young plants benched at the same time from pots, bands, flats, etc.)



Heavy branching from a single pinch made high on a strong, actively growing young plant.

TWO-YEAR CULTURE

Carrying carnation plants through for a second year's crop has been practiced more frequently the past decade, concurrent with the development of more effective disease and insect control methods and materials. Unless a bench of carnations can be kept clean during the first year and the second summer, there is no need to consider carrying it through the second winter-flowering season.

The advantages of two-year culture are: One propagation, one planting operation, one changing or sterilizing of soil, etc., plus the fact that some varieties produce more in the second year than in the first. Disadvantages commonly found are reduced flower size and stem length the second year; the need for absolute control of diseases and insects; heavier watering and fertilizer requirements the second year, and greater problems in plant support.

Two procedures are in general use. One is to cut flowers continuously through the two years; the other, to gradually pinch or head back the plants in the spring, removing those shoots which would otherwise make summer flowers. The continuous procedure should be considered only for those varieties which produce flowers of good size, color and substance in hot weather and in those colors which sell during the summer months. Red, for example, is so little in demand during the summer, that it is better to pinch potential summer flowering shoots so that the comeback will be heavy in fall and winter when the demand is greater for red.

TWO-YEAR CULTURE—Cont.

Pinching or heading back for second year production is a gradual process, not a chopping off or mowing off of plants. Starting about mid-April, pinch back all those shoots which would not flower before June 1. As new shoots come along and are long enough to pinch, repeat the procedure. Go over the bench at three-week intervals, making the last pinch about July 15. This heading back results in much heavier fall and early winter production than the continuous cutting method.

During the first year of two-year culture, the cutting or picking of flowers is done at somewhat lower levels on the plant than is the case when plants are being grown for only one season. This keeps down the overall plant height for the second season.

The greatest hazard in two-year culture is the unexpected loss of plants during the late summer between the two winter-flowering seasons. If the plants start dying out in groups it may then be too late to replant with carnations. If these losses are substantial, it is usually best to replace with a bench of snapdragons, stocks, etc., rather than nursing along a bench of ailing second-year carnation plants.

BENCHING

Particular care should be taken so that bench soils are readily workable and have proper moisture content at the time of the benching, otherwise the planting job will be slipshod and the young plants will be delayed in getting established. Although the soil need not and should not be worked powder-fine, if it is too rough it is difficult to set the plants at the proper depth and spacing, and to provide complete contact between soil and roots. Soils that are too wet at planting time are difficult to work, whereas soils that are too dry frequently delay the plants in getting established. A grower of any experience knows when soils are suited for planting. Failure to put the soil in that condition may adversely affect the crop for weeks after planting.

Do not let the planting operation get far ahead of the watering. Water soon and water thoroughly. Set the plants the same depth they were before, or a little shallower. Never set deeper.

SPACING

Spacings of 6 x 8, 7 x 7, 8 x 8, or 7 x 9 inches are in common usage. Doubling up with two plants or increasing the number of plants in the row across the bench is practiced when plants are too light to fill the bench with the regular spacing. Rooted cuttings benched direct, early planted indoor-grown plants, or field-grown plants, all can use about the same spacing in the bench.

PINCHING

The object of the first pinch is to produce breaks or to cause the young plants to branch. Pinching also sets back or impedes the growth of the plant — the lower the pinch the greater the set-back. Pinch high, leaving a liberal amount of foliage. Some varieties, such as William Sim and its sports, require particularly high pinching.

The first pinch is made about one month after the cuttings have been potted, banded, flattened or benched. Let the second set of shoots reach eight or nine inches in length before pinching them, otherwise they will come back one-for-one.

Pinching is also used to time the crop, bringing in a heavier cut at desired times, and keeping the crop down when demand is light. Varieties respond differently in length of time from pinch to bloom, and there is also a marked difference in response in any one variety at different seasons of the year. Pinching about mid-July has been the rule for bringing a number of varieties to crop in December. Closer regulation of timing now seems probable with the advent of the single pinch method used when rooted cuttings are benched direct.

Staggering the second and subsequent pinches through the spring and early summer months is a widely followed practice, aimed at spreading out the cut.

Pinching is done most easily in early morning when the plants are turgid and the tip shoots snap off sharply. Spraying with Fermate, Zerlate or Parzate, immediately after pinching is a sound disease-prevention procedure.

DISBUDDING

Disbudding is a necessary and regular practice, calculated to throw all of the energy of each stem into the production of one large central flower. Early removal of the side buds means fullest conservation of the energy for the main bud. However, from a practical standpoint, too much time is consumed in disbudding if the side buds are too small and too close to grasp easily and snap off. With a little practice, the disbudder can learn the correct twist to snap off the side buds quickly and without tearing the flowering shoot. Disbudding is one of the most time-consuming jobs in growing carnations, and many growers have found it expedient to bring in part-time or after-school help to keep up with this work.

On some varieties used primarily for corsages or boutonnieres, it may be more profitable for retail growers to leave 3 or 4 buds per stem, letting each bud develop in turn and cutting the flowers without stems.

SUMMARY OF CARNATION TIMING AT COLORADO A & M TO OCTOBER 1, 1952

(All data are for Sim Varieties)

| | First crop | Peak cut | Second crop | Peak cut |
|--|-------------|----------|---------------------|----------|
| From a single pinch made: | | | | |
| April 15 | 7/29— 8/25 | 8/5 | 11/18—2/9 | 12/16* |
| May 15 | 8/5 — 9/16 | 8/29 | 12/16—3/8 | 1/10** |
| June 15 | 9/16—11/17 | 10/7 | 2/10—5/9 | 3/9 |
| July 15 | 10/11—12/22 | 12/2 | 4/6 —6/7 | 4/27 |
| From a solid second pinch made: | | | | |
| June 15 | 9/2 —11/10 | none | 3/9 —5/9 + | none |
| June 20 | 9/2 —11/24 | none | 3/2 —5/9 + | none |
| July 10 | 11/4 — 1/19 | 12/11 | 4/13—6/7 + | none |
| July 20 | 11/4 — 2/2 | none | 4/13—6/7 + | none |
| Aug. 15 | 12/9 — 2/2 | 1/6 | 4/20—6/7 + | none |
| Sept. 19 | 1/27— 5/9 + | 2/24 | | |
| Oct. 15 | 2/24— 6/7 + | 3/30 | | |
| From a 2 and 2 staggered pinch made: | | | | |
| June 15—July 15 | 11/4 — 2/2 | none | steady cut to 5/9 + | |
| July 15—Aug. 15 | 11/25— 2/23 | 1/6 | 4/13—6/7 + 5/4 | |
| Aug. 15—Sept. 19 | 12/30— 5/9 | none | | |
| Sept. 19—Oct. 15 | 2/24— 6/7 | none | | |
| From other staggered pinches as follows: | | | | |
| one pinch per plant June 5, 20 and July 5 | 8/26—12/22 | none | steady cut to 5/9 + | |
| one pinch per plant June 5, 20 and July 5, 20 | 10/21—12/22 | none | steady cut to 5/9 + | |
| one pinch per plant July 5, 20 and Aug. 5 | 11/18— 2/2 | none | steady cut to 6/7 + | |
| one pinch per plant July 5, 20 and Aug. 5, 20 | 12/2 — 2/16 | none | steady cut to 6/7 + | |

*Third crop began Mar. 9 — cut heavily April and May.

**Third crop began Apr. 13 — cut heavily early May to June.

WATERING

Many growers aim at running their carnation soils on the dry side. This practice probably developed because of the widespread prevalence of stem rots and the tendency of these rots to be more serious in moist soils. However, permitting carnation soils to become unduly dry hardens plants and prevents optimum growth and production. For profitable operation it is better to rely on the more direct methods of preventing stem rots (see section on Diseases and Insects) and to water sufficiently and frequently enough to assure free growth.

"Avoid splashing and wetting the foliage." Insofar as this is possible it is good advice, for some diseases are spread in this manner. Water carefully and do not wet the foliage unnecessarily. However, the lower leaves are almost bound to be splashed, and it is advisable to take the following steps which minimize the dangers of wetting the foliage and spreading disease:

1. Water on bright days and complete watering as early in the day as possible so the foliage will dry rapidly.
2. Ventilate freely when watering and after watering to keep down humidity and encourage drying of the foliage.
3. In conjunction with liberal ventilation, when outdoor temperatures permit, turn in additional heat to speed the rate of drying moisture on the foliage.

During the summer months, on new and two-year plantings alike, water sufficiently to maintain active growth. Otherwise, the plants become checked and hardened and never entirely regain their lost momentum.

TEMPERATURE

A night temperature of 50° F. is optimum for carnations. Lower temperatures reduce and delay production, and higher temperatures reduce quality, particularly during the winter when daylight is inadequate. For the occasional cloudy day, a daytime temperature of 55° F. is satisfactory. During prolonged periods of cloudy weather it is better to hold the day temperature approximately the same as night temperature, 50° F.

During bright weather, daytime temperatures of 60 to 65 degrees are compatible with a 50° night temperature.

The importance of uniform temperatures can hardly be overemphasized. Fluctuating night temperatures are associated with splitting of flowers. This is particularly evident in early fall when boilers are not started up for the occasional cold nights. Two or three nights when the temperatures drop to the lower forties increase the incidence of splitting for several weeks. The value of automatic heat and temperature controls in carnation houses has been well established.

LIGHT

In most carnation growing areas light is the limiting factor to maximum growth, production and quality during the winter months. Carnations should have the lightest house or bench available, and the glass should be kept clean. In areas where summer heat is intense, some shading of the glass helps quality on benches which are in summer flower production. In those same areas, if the house is well ventilated, it is not desirable to shade houses in which carnations are not in crop.

When field plants are benched in midsummer, the glass is shaded for a week or two, while the plants are recovering from transplanting shock. As soon as they are established, the shade should be removed. In contrast with this shading requirement for field plants, it has been found feasible to bench rooted cuttings direct from the sand during warm weather, without shading the glass. With strong, vigorous cuttings, losses have been virtually nil, and the young plants develop rapidly.

Supplementary artificial light hastens bud development, but also weakens stems and reduces flower petalage, and hence has found no place in commercial production.

SUPPORTS

Carnations are supported by the wire-and-cross-string method. Wires are strung tightly lengthwise of the bench, one wire between each row of plants. Strings are tied to the wires across the bench, separating the plants in that direction. The first set of supports is strung five or six inches above the soil. The additional sets of supports are spaced eight inches apart.

Much labor is saved and fewer stems broken if each set of supports is in place before the plants reach it. Maximum growth can be achieved and crooks kept to a minimum if the shoots can come up through or be trained through a waiting support. In some carnation ranges it is an established policy to have all sets of supports ready to lower in place at the time of benching or shortly after.

Since there is a continual need for support at all levels, the supports are kept in place until the plants are thrown out. Workers should go through periodically to straighten and train shoots through the proper openings of the cross-wire supports.

VARIETIES AND PERCENTAGES

In most market areas the demand is for more than fifty per cent white and light pink combined, followed in order by red, dark pink, yellow and color novelties. The percentage of novelties demanded in most areas is extremely low, although notable exceptions exist, such as at San Francisco and Milwaukee. It is evident that retail florists have an important hand in determining these color requirements, and some retail growers have found it profitable to grow sizable proportions of the novelties for their own trade, thus making their offerings more interesting and attractive than those of the neighboring florists. The standard colors predominate in the bread-and-butter work of the vast majority of retailers.

Even with a recognized "best white" or "best red" variety, many growers prefer to grow more than one variety of a color. Because of the variation in cropping habits of the different varieties, such a procedure assures a steadier flower production. Also, since varieties "run out" or otherwise lose their desirability a grower is protected by having more than one variety of a color in production or on trial.

CUTTING, STORING, PACKING

Carnation flowers develop a little more size and quality if permitted to open on the plants, rather than being cut in tighter stages. Retail growers take advantage of this, allowing the flowers to develop to near-maturity before cutting. Wholesale growers cut at various stages, the degree of openness depending on market requirements, distances of shipping, etc. Most varieties will open in water after being cut, but a few go to sleep unless fully developed before cutting.

Both cutting and breaking of stems are practiced when picking flowers. Using a knife for cutting is more likely to spread disease from plant to plant. However, in breaking the stems, some damage is likely to be done to buds, shoots or stems below, so the superiority of either method is debatable.

Twenty-five is the standard number of flowers in the wholesale bunch. Other than that, grading standards are almost non-existent. However, the grower who uses uniformly good flowers in his regular grade and keeps culls, splits, crooks and shorts separate, is more likely to have a higher average return. Flat packs and round bunches are both used, and the advantages of each debated. The important considerations in bunching are to prevent stem breakage and to keep bruising and crushing of flowers to a minimum.

After picking, carnations require a period of several hours or overnight of storing in water in a cool atmosphere to develop firmness. Cellars and natural storages serve fairly well during much of the year, but the advantages of artificial refrigeration for a warm weather cut are too obvious to be ignored. Temperatures of 33 to 40 degrees F. are preferable to higher temperatures for carnations.

Experimental data just released by the University of Illinois shows that cut flowers keep better at room temperatures or at various storage temperatures when the water in the containers tests approximately pH 4.0, as compared to water that is more acid or more alkaline.

Gloeckner CARNATION MANUAL

CUTTING, STORING, PACKING—Cont.

Long-term cut flower storage is possible with carnations. Fischer reported that carnations stored in a moisture proof container for four weeks at 31° F. had a post storage keeping quality of 7 days. The greatest application of long-term storage may come in storing carnations several weeks or a month in order to meet heavy seasonal demands. Completely line corrugated boxes with cellophane or polyethylene, pack the flowers as is the practice today, seal over the top of the cellophane to complete the moisture proof atmosphere and refrigerate at 31°. Other ideas include the storage of flowers in large metal or waxed drums. For further information send for Cornell Extension Bulletin 853, "Commercial Storage of Cut Flowers", published by the New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Carnations are extremely sensitive to ethylene gas. Small amounts of the gas in the atmosphere produce sleepiness in the flowers. To avoid this hazard observe the following rules:

1. Keep the storage box and the containers clean, never permitting any old, decayed or diseased flowers, stems or foliage to accumulate. They may give off ethylene gas.
2. Never store fruits, vegetables or arborvitae foliage in the same box. They give off ethylene gas.
3. Be certain that coal gas and fumes from leaky gas pipes and burners never reach the flowers in storage.



DISEASES AND THEIR CONTROL

FOLIAGE DISEASES

There are three foliage diseases: Alternaria Blight and Branch Rot, Rust and Bacterial Leaf Spot:

ALTERNARIA BLIGHT AND BRANCH ROT

SYMPTOMS: Alternaria blight and branch rot probably occurs wherever carnations are grown and is most serious on plants that have been grown in the field. This is an external disease and the symptoms appear on stems, leaves and occasionally on the flowers. Tiny purple spots are the first symptoms of the disease on the leaves, and later on the spots enlarge until a light brown, dead shrunken place appears in the center. Branches of the plant are usually infected at the nodes where they girdle the stem or branch, causing it to die. Brown spots later become black, as spores of the fungus appear on the surface.

The main source of infection occurs in the cutting bench. The fungus apparently does not live over in the field. The disease is spread from plant to plant in water during syringing operations or by splashing water in the field. The spores land on leaf surfaces, germinate and enter through stomata. Infection takes most rapidly about 70° F. and free water must be present for at least 8 to 10 hours.

CONTROL: Year around inside culture with careful watering is the best preventive measure. For those who continue to grow out-of-doors, in addition to sanitation and other good cultural methods a regular weekly spraying of **Bordeaux Mixture** with a good wetting agent should be applied. Dimock has reported that **Orthocide 406** was very effective in the control of Alternaria Blight. When field culture is practiced, it is advisable to rebench as early as possible.

RUST

SYMPTOMS: Rust attacks plants from the cutting stage to the mature plant. The fungus causing rust on carnations is not the same one as the one causing rust of snapdragons or asters. The characteristic reddish-brown pustules develop on the leaves and stems. These spores may be disseminated by wind rather than water but water must be present on the leaves for infection to take place. Only a few hours are required for infection. Fungus grows inside the tissue and two to four weeks later a new crop of spores are formed.

CONTROL: Rust infection will not take place when the plants are kept perfectly dry. Secure cuttings from rust-free plants only. Under some conditions such as leaky greenhouses and for those who cannot control the moisture of the hose, a spraying with either Dry Parzate or Liquid Parzate plus zinc sulfate should be followed. Use dry Parzate at the rate of 1 pound per 100 gallons and the liquid Parzate at the rate of 2 quarts of fungicide plus $\frac{3}{4}$ to 1 pound zinc sulfate plus a good spreader in each 100 gallons. Regular spraying every ten days to two weeks should control rust under rather unfavorable greenhouse conditions. Orthocide 406 has recently been reported to be very effective in the control of rust.



Alternaria Blight — A lesion has girdled the stem and caused the death of the parts above. Black spore masses of the pathogen can be seen on surface of lesion.



Yellowish mottling and ringspot patterns produced in upper young leaves of plants affected with Alternaria Blight.

BACTERIAL LEAF SPOT

SYMPTOMS: This disease is troublesome in some areas, especially areas like the Hawaiian Islands where carnations are grown out-of-doors and where there are frequent rains. The spots are circular or oval-shaped with purplish borders. Lower leaves are affected first and then spreads upward by syringing or splashing water. Optimum temperature for its development is 75° F.

CONTROL: Bordeaux Mixture has proved to be the most effective.

Gloeckner CARNATION MANUAL

SYSTEMIC DISEASES

There are five diseases that can be classed as systemic, that is, the organism may be found in all parts of the plant: Fusarium wilt, Bacterial wilt, and three virus diseases, mosaic, streak and yellows.

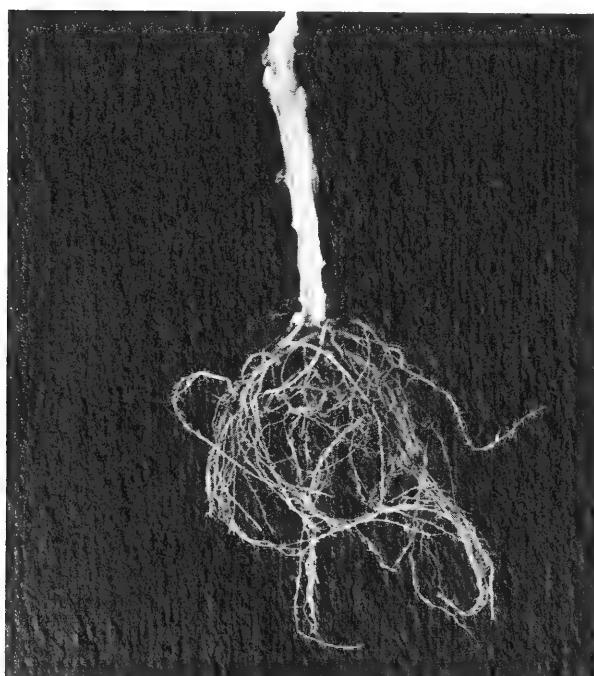
FUSARIUM WILT

SYMPTOMS: Plants infected with Fusarium may show symptoms at any stage in their development. The first indication that a plant is affected with Fusarium wilt is a slow withering of the shoot. Often this is apparent on only one side of the plant and in young plants this results in a twisting and distortion of the plant. This wilting is usually accompanied by a change in color. First the leaves and stems change to a lighter gray-green and finally to a pale straw yellow. When infected stems are split, a brownish discoloration appears in the vascular tissue from the base upward. Extensive rotting of the roots usually does not occur until very late stages of the disease.

The fungus responsible for this disease can live in soil in the absence of carnations, so new infections can occur when healthy plants are planted in infested soil in the greenhouse or in the field. Cuttings from infected plants may also carry the disease. Infection usually takes place through the roots but it may also take place through wounds in the base of the main stem. Infections develop most rapidly at 75°-80° F. and at this optimum temperature for the disease the amount of infection is increased, the incubation period is shortened, and the rate of killing of infected plants is increased. Symptoms appear in 12 to 75 days following infection.

CONTROL: Complete rogueing of infected plants together with very careful selection of propagating material will help hold this disease down. Growers who are very serious about eliminating this disease should either culture stock for a propagating block or should pot-grow a few carefully selected plants and their progeny for a period of at least one year to be sure that the plants are not diseased, and then use them as a nucleus for further propagation of the variety concerned. The pots should be well spaced and extreme care should be exercised in avoiding recontamination.

A complete program of steam sterilization should be followed to completely eliminate this disease. Do not transport soil from old benches to new after soil sterilization.



Portion of lower stem and root of plant affected with Fusarium wilt. Brown streak was evident in vascular tissues of the stem. Root System is intact.



Rust pustules on leaves.

BACTERIAL WILT

SYMPTOMS: Bacterial wilt is the disease that is causing most concern among carnation growers. It is a relatively new disease for carnations, first being found by Dr. L. K. Jones in Washington State in 1940.

Sudden wilting of the tops or some of the branches in a characteristic symptom of bacterial wilt. Either one or more branches on one side of the plant wilts or the whole plant wilts. Distortion due to the tendency of the plant to curl to one side as in Fusarium wilt is not evident when the plant is affected by bacterial wilt. Internally the stems are yellowish to brown and if wilting is confined to one side of the plant the discoloration is usually restricted to that side. The bark on the lower part of the stems disintegrates and becomes soft, and the discolored wood underneath is sticky to the touch. The root systems are rotted, most of them remaining in the soil when the plant is lifted. These roots also have a sticky character. This sticky character of disintegrating root and stem tissues distinguishes bacterial wilt from other wilt and root rot diseases.

The bacterium responsible for the disease enters through the root and basal part of stem. This is a high temperature organism and it works most effectively during the summer when temperatures are in the 90's. It works slowly in the wintertime and infected plants may not show symptoms until summertime. This is important, as cuttings are frequently taken from apparently healthy plants in the winter and the disease does not become evident until hot weather.

CONTROL: Soil sterilization with steam only; otherwise the same general precautions as for Fusarium wilt. If hormones are used on the cuttings, apply them with a powder blower, never in a solution into which cuttings are dipped.



Bacterial Wilt — Infected plants with rotted roots.



Bacterial Wilt — Showing appearance of dying plant; entire plant is affected.

SYSTEMIC DISEASES—Cont.

VIRUS MOSAIC, STREAK AND YELLOWS

SYMPTOMS: Mosaic and streak have been present in carnation plantings for many years. Mosaic is very common but seldom causes extensive damage whereas streak is less common and is more injurious. Mosaic is evident as a mottling in young, actively growing leaves. When these leaves become older this pattern is no longer evident. Flower breaks that occur in King Cardinal and in some Fisher varieties are due to mosaic and they are severe enough occasionally to produce cull bloom. Mosaic can be spread either by aphids feeding on infected plants or by rubbing the sap of a diseased plant into the leaves of a healthy plant. The virus can be transmitted to a number of garden pinks by these methods also, and in some of them the mosaic symptoms are more distinct than in the carnation plants themselves. Sweet william can serve as a good test plant for determining which carnations are affected with mosaic. Briefly, using the sweet william test, has failed to find a plant free of mosaic among a number of commercial varieties tested. Mosaic is not seed-borne and seedlings will remain free unless contaminated.

Streak is marked by broken lines or streaks in the leaves. These short streaks may be white, yellowish brown, or purplish. These symptoms are plainly expressed in older leaves of established plants in spring, especially during March to May. Post reports (1947) that he found only slight expression of streak in St. Louis and Los Angeles plantings, but it was widespread in San Francisco and Denver greenhouses. Evidently low temperature intensifies the expression of the disease. Streak is not transmissible by grafting. It does spread among plants grown out-of-doors and so some insect carrier of the disease is suspected, although none as yet has been found. Yellows is merely a combination of mosaic and streak.

CONTROL: Since all known standard varieties of carnation have mosaic it is impossible to control this disease unless we start the stock from seedlings. Such is the case with the new Yoder Brother varieties. These seedlings have been kept in isolation and away from all existing named varieties plus the control of all aphids.

Streak may be eliminated by careful rogueing and selection of propagating stock and by keeping the plants in screened greenhouses throughout the year. Some workers in Colorado believe that streak is no more than an expression of aster yellows which is spread only by aster leaf hoppers, so once a streak-free clone is established, it could be maintained in a healthy condition by screening and occasional rogueing.

All Photographs of Carnation Diseases in this Manual provided through the courtesy of the Illinois State Natural History Survey, Urbana, Illinois.



Leaves of young shoot of healthy plant at left and mosaic plant at right. Leaves of healthy plant have a uniform dark green color; leaves of diseased plant are light green and mottled.



White streaking in flower due to mosaic Natural color of flower solid pink.

ROOT AND STEM ROT

There are two root and stem rot diseases: Rhizoctonia stem rot and Fusarium foot rot.

RHIZOCTONIA STEM ROT

SYMPTOMS: This disease is characterized by a progressive wilting, collapse and browning of the entire plant, associated with a soft decay at the soil line. The stem at the soil level is soft and moist and the bark is easily rubbed off. It is not sticky, however, and the wood beneath the bark remains firm. The roots remain intact. The fungus, Rhizoctonia, is almost universally present in soil and it can attack carnations at any stage from the cutting bench to the mature plant in the bench. High soil temperatures and soil moistures both favor the disease and losses are highest during the summer months. Deep planting also contributes to the efficiency of the disease.

CONTROL: Steam sterilization is the only preventive measure. Inside culture is by far the better over out-of-door culture. Dimock reports that in cases where Rhizoc begins to show up in an occasional spot in a sterilized bed, immediate drenching of the affected area and the soil for a couple of feet beyond the obvious infection with a suspension of Semesan at the rate of 1 pound to 50 gallons water or approximately 1 rounded tablespoonful per gallon will hold this disease in check. It might be advisable to make a second application at about half the above dosage rate in about ten days. Because there is always some danger of a little injury from the chemical, it is not recommended as a general prophylactic treatment, but suggested as a means of definitely stopping further advance of accidental contamination. Planting high, with the top of the original root ball somewhat above the general bench level, has been found quite effective in reducing trouble from Rhizoc.

FUSARIUM ROOT ROT AND STEM ROT

SYMPTOMS: Fusarium root rot and stem rot is distinct from Fusarium wilt. When plants are affected with root rot the entire plant wilts, the roots rot and slough away to the root base and some rotting of the base of the stem may take place but there is no extensive vascular discoloration as in Fusarium wilt or bacterial wilt. Extensive losses may occur in the cutting bench as diseased cuttings usually fail to root, or root poorly. The disease is most serious in young plants and in soil that is kept excessively wet. Fortunately for control, the organism does not spread into the upper parts of the plant.

CONTROL: Follow the general sanitation practices such as steam sterilizing, proper use of the hose, and the avoidance of wet soil.



Yellows. Leaves from plant affected with both mosaic and streak.

Mottling and streaking of leaves in plant affected with mosaic and streak viruses.

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FLOWER AND BUD ROTs

There are two flower and bud rot of carnations: Botrytis flower blight and Fusarium bud rot.

BOTRYTIS FLOWER BLIGHT

SYMPTOMS: Petals of flowers affected with Botrytis turn brown either while in bud or after the flower opens. Frequently a number of petals may be matted together by the growth of the fungus and if the weather remains warm and moist the affected petals soon become covered with the brownish-gray growth of the organism. This brownish-gray growth is covered with a powdery mass of spores.

Botrytis flower blight occurs only during periods of extremely high humidity and the Botrytis spores are produced in large numbers when the atmosphere is warm and damp. Such conditions provide an ideal environment for the germination of the spores and growth of the organism. If the weather becomes dry the fungus does not develop further and the affected parts become brown, dry and brittle. This organism does not affect other parts of the carnation although it may affect many other kinds of plants. The spores are numerous and are readily disseminated by slight air currents.

CONTROL: The only proven control for this disease is proper use of heat and ventilation. Heat should be started in the houses an hour or two before sundown and if the vents are left open a bit so that the moisture-laden air can move out, there will be little trouble experienced with Botrytis blight. Northland is a very susceptible variety and it has been suggested to plant this variety in a south bench or in houses which have the best ventilation.

FUSARIUM BUD ROT

SYMPTOMS: The symptoms of Fusarium bud rot are quite different from those of Botrytis in that young buds may appear outwardly normal, but when opened they show a moist, brownish, decayed mass of the inner floral organs. These tissues may be rotted through by the Fusarium which is generally visible as a white cottony growth. Large white fat mites are also present in this tissue. White varieties of carnations are more susceptible than colored varieties.

This disease has a very interesting relationship. The fungus itself produces a disease on various common grasses known as silver top and these infected grasses are the source of the carnation disease. However, for infection to take place in carnations, a mite *Pediculopsis grammium*, is necessary. This mite carries the fungus into the carnation buds and wounds the tissue so that the fungus can enter the tissue. Then the mite feeds on the fungus as it grows. Thus, there is a sort of symbiotic relationship between the disease organism and the insect. The mite is necessary to dissemination and infection by the organism and the growing organism is necessary for the subsistence of the organism.

CONTROL: Picking off the infected buds as soon as they are detected plus a good insect control practice in the greenhouse will check the spread of this disease.

INSECTS AND THEIR CONTROL

The insects attacking carnations are: aphid, cabbage looper, corn ear worm, four line leaf bug, Fuller's Rose beetle, fungus gnat, grass mite, greenhouse leaf tier, leaf hopper, mealy bug, red spider mite, slug, sowbug, tarnished plant bug, thrip, variegated cut worm and wire worm.

Red spider mites, aphids and thrips are by far the most common of these pests. HEPT or TEPP and Parathion are effective as aerosols. Parathion in spray, dust, or aerosol controls all the insect pests which attack carnations excepting slugs which are controlled with a metaldehyde bait.

Root knot nematodes also affect carnation plants. The affected plants become dwarfed and yellowish and if the roots are examined one will find enlarged roots. The nematode is carried in the soil. Steam sterilization should be practiced.

YODER BROS. CARNATIONS 1953 INTRODUCTIONS

WHITE

ACHILLES —A large clear white with deeply serrated petals. The flower is larger, and the variety is more productive than Jupiter. A fast, early producer on long, strong stems. Makes a free comeback in winter and is a good all-year white. Fine in summer.

JUNO —A medium-sized, flat and well-formed white flower with a very full center. Makes a free comeback in winter. Crops rapidly from a uniform pinch and comes back vigorously. This variety is equally good in fall, winter and spring and is a good keeper and shipper.

PINK

CUPID —A true Briarcliff pink with a small flower. Cupid is a high producer, best from December through April. The color is also excellent in summer, but the flower is small. A good keeper, this is a "bread and butter" variety.

EROS —A light pink, similar to Aphrodite but much deeper in summer and early fall. Vigorous heavy growth, long stems, early flowering and a fast comeback characterize this variety. It has large flowers and good average production. It has a tendency to split in the early fall.

PANDORA —A dark pink with sufficient salmon tones to make it beautiful in artificial light. The color fades in the heat but is outstanding from December through early May. Good average production. Fine substance.

CRIMSON

TITAN —The flower is full and an intense crimson of good substance. Not quite as tall as Vulcan, it gets into production fast and is a consistently high producer.

SCARLET

SIREN —A bright scarlet that combines heavy production with a fast comeback and uniform cropping on stems of medium length. Height is about the same as Aphrodite, with production equal to Apollo. Good growth habit and fine flower quality assures Siren an important place among the reds.

VARIEGATED

CASSANDRA —A lively yellow variegated with pink penciling, similar in coloration to Orion, although the flower is larger and the stems stronger. An outstanding keeper, the flowers never split and have excellent substance.

PRICES FOR ABOVE:

| <u>PER 100</u> | | | | | |
|----------------|---------|---------|---------|-----------|----------|
| 50 | 100-250 | 300-450 | 500-950 | 1000-2450 | 2500 Up— |
| 15.00 | 14.25 | 13.50 | 12.75 | 12.00 | 11.25 |

Prices for 50 or multiples of 50 of a variety per shipment. Prices effective to September 1, 1953.

YODER BROS. CARNATIONS INTRODUCED IN 1952

WHITE

ADONIS—A winter variety with satisfactory but small flowers. A good producer. It is inclined to be a grassy grower.

AURORA—An exceptionally large white with strong stems. Does best in higher than average carnation temperatures, and therefore can be suggested for late spring and early fall.

JUPITER—A large white with a very strong stem, it gives competition to Northland. The occasional slight incurving of the petal edge is not associated with nor does it develop into sleepiness.

PINK

APOLLO—*The Outstanding Yoder Introduction.* Well suited to all areas of the country. Larger than Netta. This promises to become the foremost salmon pink grown.

APHRODITE—A clear light pink which has created much interest among retailers. The outside petals bleach a little in late spring and early fall but do not burn. An early producer with an early comeback, best in areas of relatively high light intensity. It does not like to be crowded.

DIANA—A good commercial type with excellent production. Growers of Fischer varieties will favor this light pink which adapts itself well to summer production.

VENUS—A show variety with salmon-pink flowers excellent in every respect. Its long stems should not be overlooked. Similar to charm in some respects.

ROSE

MINERVA—An unusual deep scarlet-pink. It fades, but uniformly so, in high light intensities. Breaks back heavily and is a fine keeper.

SCARLET

CERES—This is a very small flower except in December through May. Resembles King Cardinal in color. Production is exceptional, and it comes back into crop quickly.

NEPTUNE—A scarlet resembling the color of William Sim. Breaks freely. We believe the new Siren to be superior, however.

CRIMSON

VULCAN—A fine flower in the crimson or maroon group. Should supersede varieties now available in this color class. An excellent keeper. Comes back readily.

YELLOW

MIDAS—The best yellow carnation and the *Second Outstanding Yoder Introduction.* It has an excellent market demand. Production is very satisfactory. It responds best when kept vegetative.

VARIEGATED

ORION—The color closely resembles Glowing Ember and is also much like the new Cassandra which, however, has a larger flower. An excellent grower and producer.

SATURN—A beautiful bronze variegated. Excellent under artificial lights. Retailers' interest already indicates that this promises to become a truly popular variety.

PRICES FOR 1952 INTRODUCTIONS:

| <u>PER 100</u> | | | | | |
|----------------|----------------|----------------|----------------|------------------|-----------------|
| <u>50</u> | <u>100-250</u> | <u>300-450</u> | <u>500-950</u> | <u>1000-2450</u> | <u>2500 Up—</u> |
| 13.50 | 12.80 | 12.15 | 11.45 | 10.80 | 10.10 |

Prices for 50 or multiples of 50 of a variety per shipment. Prices effective to September 1, 1953.

Gloeckner CARNATION MANUAL

CARNATION CUTTINGS

MEDIUM PINK

| | per 100 | per 1000 |
|---|---------|----------|
| Baum's Supreme—large flowered cerise pink..... | \$15.00 | \$125.00 |
| Belvedere—light pink..... | 22.00 | 180.00 |
| *Boston—medium pink..... | 22.00 | 180.00 |
| Catron's Pink Sim—light pink..... | 20.00 | 150.00 |
| *Citation—Rose Pink..... | 15.00 | 125.00 |
| *Mrs. Eleanor Roosevelt—sport of Northland..... | 20.00 | 150.00 |
| Mrs. Virginia Irwin—medium pink..... | 12.00 | 100.00 |
| *Rosalie—bright medium pink..... | 15.00 | 125.00 |
| Virginia Rose—rose virginia..... | 10.00 | 80.00 |

DARK PINK

| | | |
|---|-------|--------|
| Canup's Pride—productive dark pink..... | 15.00 | 125.00 |
| Dark Pink Virginia—dark pink..... | 10.00 | 90.00 |
| Chalfont—dark pink..... | 20.00 | 150.00 |
| *Fanfare—new bright deep pink..... | 20.00 | 150.00 |
| *Saugus Pink—new deep pink..... | 22.00 | 180.00 |
| Sidney Littlefield—large rose pink..... | 15.00 | 125.00 |
| *Spicy Rose—rose pink..... | 20.00 | 150.00 |
| Virginia Miller—dark pink..... | 12.00 | 100.00 |

LIGHT PINK

| | | |
|--|-------|--------|
| Gordon—delicate shell pink..... | 22.00 | 180.00 |
| Improved Olivette—larger and cleaner Olivette..... | 20.00 | 150.00 |
| Light Pink Littlefield—color similar to Hercules Virginia..... | 20.00 | 150.00 |
| *Pink Lady—light pink..... | 20.00 | 150.00 |
| Pink Sim—Peterson's light sport..... | 20.00 | 150.00 |
| Princess Elizabeth—light pink..... | 15.00 | 125.00 |
| Virginia Hercules—large Pink Virginia sport..... | 15.00 | 125.00 |
| Virginia Supreme—improved Virginia..... | 12.00 | 100.00 |
| Portland Pink..... | 20.00 | 150.00 |

SALMON PINK

| | | |
|--|-------|--------|
| *Charm—salmon pink..... | 20.00 | 150.00 |
| *Coral—light salmon pink..... | 22.00 | 180.00 |
| *Excellence—large flowered salmon..... | 25.00 | 200.00 |
| *Janie—light salmon..... | 22.00 | 180.00 |
| Salmon Virginia—medium salmon..... | 15.00 | 125.00 |

WHITE

| | | |
|---|-------|--------|
| Northland—large white..... | 12.00 | 100.00 |
| Olivette—Excellent white..... | 10.00 | 80.00 |
| Patrician—an old favorite..... | 10.00 | 90.00 |
| *Peace—large pure white..... | 20.00 | 175.00 |
| Shangri-La—good keeping white..... | 15.00 | 125.00 |
| White Baum's Supreme—sport of Baum's Supreme..... | 15.00 | 125.00 |
| *White Littlefield—sport of Sidney Littlefield..... | 20.00 | 150.00 |
| White Sim—white sport of Wm. Sim..... | 15.00 | 125.00 |

CRIMSON

| | | |
|--|-------|--------|
| *Crimson Sphinx—bright crimson, sport of Sphinx..... | 20.00 | 150.00 |
| C. W. Weld—deep crimson..... | 12.00 | 100.00 |
| *Tupper—bright crimson..... | 22.00 | 180.00 |
| Woburn — crimson..... | 10.00 | 90.00 |
| No. 14 Crimson—good producer..... | 12.00 | 100.00 |

*Patented or restricted varieties

WE CAN SUPPLY ANY OTHER VARIETY NOT LISTED ABOVE.

SEE PAGES 21 AND 22 FOR ADDITIONAL LISTS (YODER BROS. VARIETIES). Prices continued next page

Gloeckner CARNATION MANUAL

CARNATION CUTTINGS

| RED | per 100 | per 1000 |
|---|---------|----------|
| Dark Red Sim (Kintzles)—shade darker than William Sim..... | \$20.00 | \$150.00 |
| *Jumbo Cardinal—deep cardinal..... | 15.00 | 125.00 |
| Laisy Dark Sim—Full dark red..... | 20.00 | 150.00 |
| No. 16 Red—King Cardinal red..... | 12.00 | 100.00 |
| *Red Beauty—scarlet red..... | 20.00 | 150.00 |
| *Schaefer's Red—red sport Schaefer's Pink..... | 20.00 | 175.00 |
| *Tom Knipe—large red..... | 15.00 | 125.00 |
| *William Sim—standard red..... | 20.00 | 150.00 |
| *Wooster Scarlet—new scarlet red..... | 12.00 | 100.00 |
| YELLOW | | |
| Canary Queen—rich canary yellow..... | 22.00 | 180.00 |
| Colorado Gold—tall yellow gold..... | 20.00 | 150.00 |
| Desert Sun—creamy yellow buff..... | 22.00 | 180.00 |
| *Harvest Moon—yellow gold sport William Sim..... | 20.00 | 150.00 |
| Miller's Yellow—clear yellow..... | 12.00 | 100.00 |
| *Patten's Yellow—strong stemmed yellow..... | 20.00 | 150.00 |
| VARIEGATED | | |
| Aura—Light yellow, orange-red markings..... | 15.00 | 125.00 |
| Baby Bronze—bronze buff with pink center..... | 20.00 | 150.00 |
| *Bing Crosby—yellow with rose pink edge..... | 20.00 | 150.00 |
| Butterscotch—yellow buff with pink center..... | 20.00 | 150.00 |
| Coopers' Variegated—variegated red and white Sim..... | 20.00 | 150.00 |
| Coronet—yellow-red pencilling..... | 10.00 | 90.00 |
| Dairymaid—white-pink pencilling..... | 10.00 | 90.00 |
| *Fuchsia—Solid Fuchsia color (500 minimum order)..... | — | 150.00 |
| Geiger's Variegated Sim—white with red splotches..... | 20.00 | 150.00 |
| Georgiana — variegated..... | 10.00 | 90.00 |
| Harlequin—orchid & lavender..... | 15.00 | 125.00 |
| *Lavender Rose—lavender..... | 15.00 | 125.00 |
| Louisa—raspberry and white..... | 20.00 | 150.00 |
| *Mohawk—yellow variegated pink..... | 22.00 | 180.00 |
| *Mrs. E. F. Guba—Almond with deep pink edge..... | 20.00 | 150.00 |
| Orange Virginia—orange sport of Virginia..... | 10.00 | 90.00 |
| Pelargonium—maroon with white edge..... | 15.00 | 125.00 |
| Peppermint Stick Littlefield—color like Pink Art..... | 20.00 | 150.00 |
| Raspberry Ice—white novelty with orchid..... | 20.00 | 150.00 |
| Scarlet King—sport of Pelargonium..... | 15.00 | 125.00 |
| Sim's Gayety—flesh pink with red streaks..... | 15.00 | 125.00 |
| *Sophie—white, variegated pink..... | 20.00 | 175.00 |
| *Sphinx—rose with crimson stripes..... | 15.00 | 125.00 |
| *Starlite—variegated white..... | 15.00 | 125.00 |
| *Symphony—reddish purple on mauve..... | 20.00 | 150.00 |
| *Tetra-Sarah Jane—A tetraploid Sarah Jane Knipe..... | 25.00 | 200.00 |
| Variegated Littlefield—blush pink sport of Littlefield..... | 20.00 | 150.00 |

*Patented or restricted varieties

WE CAN SUPPLY ANY OTHER VARIETY NOT LISTED ABOVE.

SEE PAGES 21 AND 22 FOR ADDITIONAL LISTS (YODER BROS. VARIETIES).

Varieties for 1952-53 Introduction

| | | |
|--|------------------|--------------------|
| BELVEDERE—A pleasing rose pink of clean upright growth. Does not split at any time of the year. Substance and keeping qualities are excellent. Ships well. | \$22.00 per 100. | \$180.00 per 1000. |
| DARK RED SIM—A dark red sport of William Sim. It has no white specks and is a more uniform red during the winter than the parent. The pistils do not extend as far as they do on the parent. | \$20.00 per 100. | \$150.00 per 1000. |
| FANFARE—An inbred seedling of William Sim and Peter Fisher. Bright deep pink flowers measure 3 to 3½ inches. Restricted until 1953. | \$20.00 per 100. | \$150.00 per 1000. |
| LIGHT PINK LITTLEFIELD—A new sport of Littlefield. A true light pink that holds its color well in hot weather. Color is similar to Hercules Virginia. | \$20.00 per 100. | \$150.00 per 1000. |
| PEACE—A pure white cross of Schaefer's Pink and Puritan. A strong grower, it produces stiff stems and does not split. Restricted. | \$20.00 per 100. | \$175.00 per 1000. |
| PEPPERMINT STICK LITTLEFIELD—A new sport of Littlefield with coloring very similar to that of Pink Art. | \$20.00 per 100. | \$150.00 per 1000. |
| TETRA-SARAH JANE—A true tetraploid of Sarah Jane Knipe. Colored like the original variety, the flower is up to an inch larger and the foliage is heavier. Stems are thicker and stronger. Splitting is rare. Patent applied for. | \$25.00 per 100. | \$200.00 per 1000. |
| VARIEGATED LITTLEFIELD—A new sport of Littlefield. Blush pink in color. | \$20.00 per 100. | \$150.00 per 1000. |

INSECTICIDES, FUNGICIDES AND FUMIGANTS

| | | | | |
|--|--------------------------|----------------|------------------|-------------------------------|
| Aramite 15 W | 4 lb. bag | 3.20 | | |
| Calcium Cyanide G. Fumigant | 5 lbs. | 3.75 | 25 lbs. | 12.50 |
| Deenate 75-W (DDT) | 4 lbs. | 2.25 | 48 lb. Case | 21.60 (12-4 lb. bags) |
| Detex | gal. | 11.00 | 5 gals. | 50.00 |
| Fermate | 3 lbs. | 2.45 | Case (36 lbs.) | |
| | | | | 25.80 |
| | | | | <u>carton of 24 units</u> |
| Fulex Parathion Fumigator | Size of unit | | | |
| | 1,000 cu. ft. | | | 9.00 |
| | 2,000 cu. ft. | | | 9.00 |
| | 5,000 cu. ft. | | | 12.00 |
| | 10,000 cu. ft. | | | 15.00 |
| | 20,000 cu. ft. | | | 24.00 |
| Isotox 1.5 (supplied in 50 lb. bags only) | | | | 20.00 |
| | | | | 50 lb. bags only |
| Lethalaire G-52 Bombs ("TEPP") | 4 lb. cylinder | | | 6.50 |
| Lethalaire G-54 Bombs (PARATHION) | 4 lb. cylinder | | | 8.00 |
| Lethalaire G-56 Bombs ("HETP") | 4 lb. cylinder | | | 6.50 |
| Nicofume Liquid | gallon (8 lbs.) | | | 11.95 |
| Nicofume Pressure Fumigators | ½ lb. cans (12 cans) | | | 4.60 |
| | 1 lb. cans (12 cans) | | | 7.95 |
| NNOR | gal. 10.00 | | | |
| Optox (10% DDT) | gal. 12.00 | | | |
| Orthocide 406 | 5 lbs. 7.50 | | | |
| | 20 lb. drum 22.00 | | | |
| | 40 lb. drum 42.00 | | | |
| Plant Fume 103 | 5,000 cu. ft. carton—36 | | | 10.50 |
| | 20,000 cu. ft. carton—12 | | | 12.00 |
| Parathion Dust 2% | 25 lbs. 3.75 | | 50 lbs. 7.50 | |
| Parathion Spray 15% Wettable | 4 lb. bag 2.88 | | 25 lbs. 16.75 | |
| | | | 50 lbs. 32.50 | |
| Parzate | | | | Case (36 lbs.) |
| (Powder) | 3 lb. bags 2.85 | | | 31.20 |
| (Liquid) | 5 gal. cans 9.50 | | | |
| P-40 | 25 lbs. 7.25 | | 50 lbs. 13.75 | |
| | 100 lbs. 26.00 | | 1000 lbs. 245.00 | |
| Sodium Selenate | lb. 7.00 | | | |
| Vapotone | gal. 11.90 | | | |
| Zerlate | 3 lbs. 2.45 | case (36 lbs.) | 25.80 | |

For your other needs refer to your

*Gloeckner Chrysanthemum Manual and
Seed Catalog*

Gloeckner

CARNATION
MANUAL